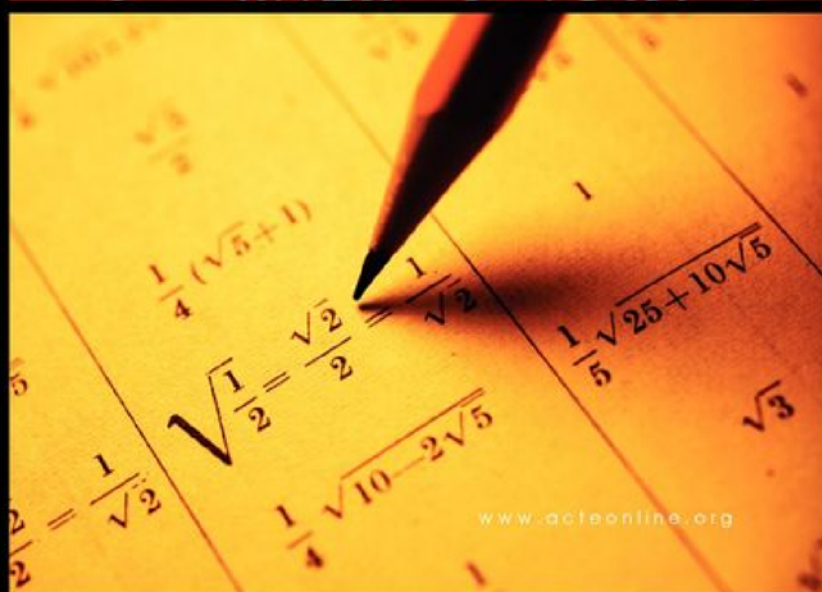


Bolstering a STEM pipeline in Ohio



We STEM, do you? Miami Valley Career Technology Center's Answer to implementing STEM

BY KELLY J. HERZOG

Ohio has been hit hard by the current economy. Industries and jobs that had sustained generations of families are no longer options for today's workers, thus creating entirely new workforce needs. To improve the standard of living for the United States, today's jobs require more knowledge and higher-level thinking skills than ever before. The gap between what current students need to know for the workforce and what they actually know continues to widen.

Research reflects that graduates are leaving high school deficient in math, science and problem solving skills necessary for the demands of the workforce. As industry evolves, the increased need for a higher skilled workforce is evident. The coveted employee is one who can solve problems and communicate with others. A systemic change in the delivery of education is needed to provide this highly skilled worker. This redefined delivery system must enhance the development of intellectual capacity and generate more technologically literate citizens.

No longer can we use curriculum that meets the needs of only 10 percent of our students. In order to maintain a competitive position in high tech industries and attract new business we must have a system where all students develop a confidence in learning math, science and highly developed problem solving abilities.

Taking into consideration the already existing methods of instruction used in

career and technical education (CTE) labs and the demands of the emerging workforce, Miami Valley Career Technology Center (MVCTC), located in Clayton, Ohio, implemented the new science, technology, engineering and mathematics (STEM) Academy for high school juniors and seniors in the fall of 2007. The goal of the new program is to provide more rigorous math and science knowledge for all students, not just those considered academically high achievers.

"MVCTC has defined the engineering in STEM as a verb, not a noun," says Nick Weldy, MVCTC math and science supervisor. "This means we do not limit ourselves to delivering the curriculum only to those wanting to enter an engineering field, we see STEM as engineering solutions and solving problems."

Ohio Core

To implement STEM in all Ohio schools, the Ohio legislature recently passed the Ohio Core—a program designed to better prepare students for college by promoting a more rigorous curriculum for secondary students and changing the minimum high school graduation requirements. Key components of the Ohio Core include:

- increasing math requirements from three units to four, including Algebra II or equivalent;
- teaching science courses as inquiry-based lab experiences;
- incorporating economic and financial

literacy into the curriculum;

- offering college preparation on the high school campus;
- including foreign language, fine arts, business technology and CTE studies as elective choices for all students.

However, STEM is not just about taking more math and science classes; rather it is about engineering solutions to problems using the tools of math and science in conjunction with the latest technology. The inquiry-based lab experiences suggested by the Ohio Core are designed to teach students how to think, how to research, and how to discover on their own. In this system, the teacher becomes not just the giver of knowledge but also the facilitator of the learning process, while students learn to take ownership for their education.

The MVCTC approach fits perfectly with the guidelines of Ohio Core. MVCTC has restructured its curriculum to integrate academic studies in STEM and CTE disciplines. The classes use inquiry-based learning (IBL) to help students solve problems and develop critical thinking skills. Teams of teachers are guiding students to question, analyze and find solutions to real-world problems.

Inquiry-based Learning Model

MVCTC instructors and administrators have worked to integrate academic and CTE disciplines using the concept of IBL. It is an instructional delivery system used by instructors to:

- help ensure transferability of STEM knowledge to real-life scenarios;
- initiate students to ask an “essential question” which revolves around current issues in business and industry related to each student’s career field;
- require students to become

- problem solvers; and
- connect to students’ world.

“The IBL is centered on a problematic situation that is open and not structured well, meaning that there are no easy answers. It is initiated by an essential question that drives the student’s efforts

and will help the student to become a problem solver instead of just repeating information back to the teacher and then being assessed on their response,” says Weldy. “No more get and forget. IBL is unique in that it relates to students’ world by tying together their career fields along with math and science.”

Essential Question

So what is an essential question? Weldy shares in his presentation on STEM that, “the essential question revolves around current issues or problems in business and industry. MVCTC teachers have been using resources, such as *USA Today*, to pull out articles that tie in math and science. They then take these articles and develop essential questions for the students.” The teachers must evaluate each potential problem carefully and examine them to ensure that the resulting essential question will:

- lack vital information when first encountered.
- defy an easy solution (no $2+2=4$).
- connect with students’ world.
- ensure that students cannot be 100 percent correct with their response because they will not have all of the data; but decisions have to be made as they would be in the real world. Few, if any, business and industry leaders are fortunate enough to have all the data they need when they make a decision.

Achieving Success

There have been many key components to developing the successful STEM academy at MVCTC, including the use of technology, professional development, collaboration periods among instructors, and recognizing the need for literacy skills in the math and science area. The academy allows for collaboration among math, science and CTE instructors to create relevant STEM lessons for students in allied health, computer information technology,

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construction technology and graphic arts. The model has been very successful and will expand to include additional CTE programs in the future.

Regionally, the academy has been named an outstanding program by Montgomery County, Ohio P-20 counsel ED-vention, and the Southwest Ohio School Boards Association. MVCTC has had two staff members named STEM Fellows and has been tasked with assisting other local districts in STEM curriculum development; meeting with area professionals in research, education and business and industry to develop IBL-STEM lessons; and expanding the influence of STEM in the Miami Valley. The academy has also hosted international visitors from Kuwait and Singapore.

In the spring of 2009, the national organization American Youth Policy Forum (AYPF) selected the academy as an exemplary school for its focus on the STEM

topics. AYPF visited MVCTC as part of a two-day study trip to Ohio for select state policy leaders from five states interested in learning about successful practices for infusing STEM into high school education. Participants toured the school and participated in conversations with the leadership and student body of MVCTC. Loretta Goodwin, senior director of AYPF said of the visit to MVCTC, "We selected MVCTC because of its strategic focus on STEM subjects, and ensuring that students are acquiring 21st century skills. During an interactive question-and-answer period with participants, school staff noted their commitment to receiving professional development about inquiry-based learning, while a panel of students shared openly about their hands-on learning experiences at the school. As they discussed their projects, it was clear that students were engaged in not only learning about a particular issue, but were also

able to reflect on their learning and see the real-world relevance of their projects. They also testified to the commitment of teachers to their progress."

When the AYPF group visited MVCTC to learn more about the academy, a group of current MVCTC students in STEM classes participated in a discussion panel to share their experiences. They commented on math and science having been some of their least favorite subjects before attending MVCTC. But by learning in context to their CTE program, math and science are some of their favorite subjects, they said. "True STEM isn't about more math and science but better math and science," says Weldy. **I**

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